The CenterScene

FALL 1990


*USGS and NASA officials meet the press at the August 28, 1990 dedication.*

# EOS: An Important Initiative

On August 28, 1990, Dr. Lennard A. Fisk (NASA Associate Administrator for Space Science) joined Dr. Dallas Peck and other representatives of the USGS to announce a major program at the EROS Data Center. EROS will be the location for processing and distributing land data acquired by the Earth Observation System, part of NASA's "Mission to Planet Earth."

"Mission to Planet Earth" is a major space based program to examine the planet and the potential global effects of climate and environmental change. Drs. Fisk and Peck unveiled a model of the proposed addition to the current Center facility. The additional building of approximately 65,000 sq. ft. is planned to house data processing and research components.

The challenges of an industrialized world society, and an increasing awareness and concern for natural and human induced global change have led to formulation of a Global Change Research Program in the United States. In the next decades, major economic and scientific resources will be devoted to long term studies of interactive environmental systems. Key contributions to the U.S. Global Change Research Program will be provided by a new national program called the Earth Observing System (EOS). Three essential components of EOS are a space-based observing system, a Data and Information System, and a scientific research program. As a result of nearly two decades of experience in satellite data processing experience, the EROS Data Center has been selected to play an important data management role in support of EOS. The EROS Data Center will be the major national archive for land processes data acquired by EOS.

EOS will build on the scientific approaches developed in the past twenty years of using space-based data. Historically, satellite programs have repeatedly demonstrated the importance of the synoptic view of large geographical regions. Research and application of data collected by satellite have illustrated the necessity of examining the integrated effects of environmental change. Further, the profusion of international data sets, and attempts to apply these data sets to real problems in environmental assessment, has shown the value of a consistent set of standards for any interchange of date sets. Spaceflight has permitted consistent global coverage on a frequent basis and has enabled scientists to establish comprehensive measurements of environmental systems using a variety of scientific and analytical techniques.

For example, temperature fluctuations at surface weather stations may be influenced by changing land use and those changes may affect surrounding land areas and cross boundary water bodies. Scientists from a number of countries may need ready access to climate data, land use patterns and sediment flow from rivers to develop their integrated analysis. Complementary research based on global data sets will be in large part dependent upon space-based data acquisition systems such as those included in EOS.

EOS will build on that scientific tradition involving many countries in mission planning, instrument and support system design and long range system and facility development. Platforms and instrumentation will be contributed by the European Space Agency, individual European countries, Japan and Canada. EOS will go much further toward meeting the scientific requirements of the international community than a series of separate, uncoordinated programs planned independently. As global environmental changes involve many factors, EOS programs will follow an integrated, international approach to analysis of these factors.

EOS will use a number of satellite platforms making daily measurements with a series of advanced instrument packages. Two polar orbiting platforms to be launched in the late 1990's, with 16 day repeat cycles, at altitudes of approximately 700 km, will carry various instrument packages to measure global environmental conditions. Of particular import to the EROS Data Center are those systems used for land processes

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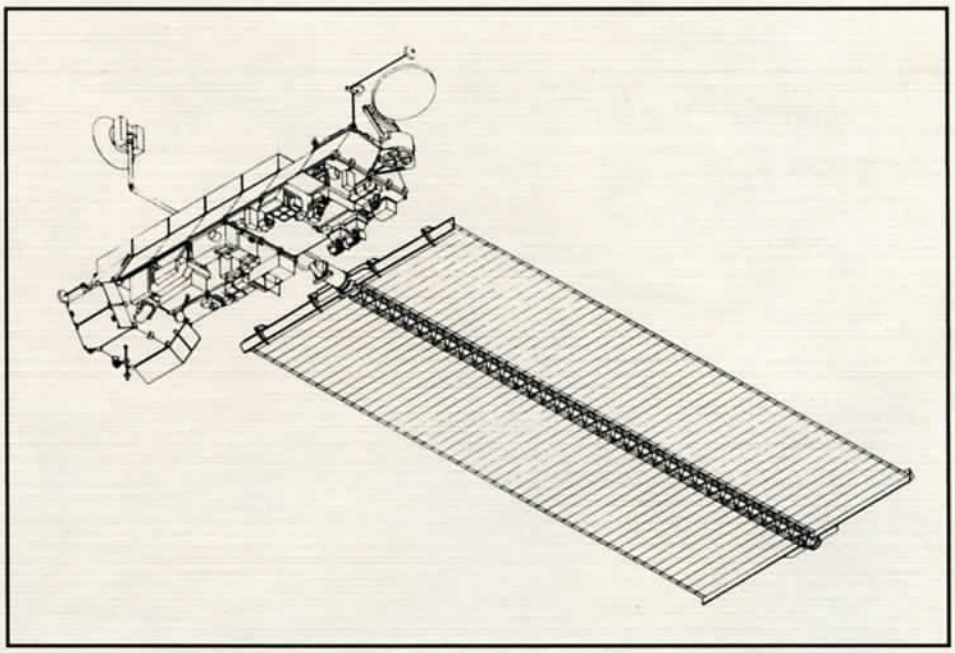
# UP FRONT

This column appears in the first issue in a new series of Center Scene. The newsletter, like the Data Center, has undergone some recent changes and will continue to evolve and grow in response to the needs of the times. The timing of this issue is appropriate because it coincides with some of the good news that we have had recently.

The ceremonies on Tuesday, August 28th marked an historic event in the life of the Center. The renewal of our partnership with NASA in an innovative and crucial research mission recognizes our past achievements and provides a firm foundation for many years of active research and data management responsibility. NASA's "Mission To Planet Earth" is a major space-based program and its Earth Observing System (EOS) land data will be our responsibility. These data will find wide application in global change research. Global studies, involving cooperative programs with national and international scientific groups, will be important to the understanding of environmental factors and man's interaction with our planet.

In part, this column is a letter of thanks to each of you. Without your products, your papers, your research, your contributions, in short without your continuing effort and dedication, the EROS Data Center would not have been considered for this vital new role. Because of you, we were prepared to be responsive when the opportunity came. I am enormously proud of your accomplishments, your hard work, and your loyalty, and I thank you.



## EOS

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research and application. They include:

- Moderate Resolution Imaging Spec trometer (MODIS). MODIS is based on two instrument sets, MODIS-N (nadir) and MODIS-T (tilt). It represents an advance on several instruments, including the NOAA AVHRR, that have provided data on the Earth as a system. MODIS will provide long-term daily observations of dynamic features occurring in the lower atmosphere and at the surface, through multispectral measurements extending from the visible through the thermal infrared ranges of the electromagnetic spectrum.

  For example, the 64 bands capability of MODIS-T will provide improved atmospheric corrections, better calculations of aerosol distributions, and some ability to distinguish major groups of phytoplankton. The enhanced level of quantization will permit good data to be acquired over coastal waters.

  MODIS-N has bands specifically positioned to measure cloud-top pressure, cloud-water thermodynamic phase, and cloud-optical thickness.

  MODIS will considerably extend capabilities for studies of tropospheric dynamics, cloud climatology, and simple atmospheric chemistry involving water vapor, temperature, aerosols and ozone. Additionally, MODIS will provide global observations of snow and ice cover, normalized vegetation index, and other parameters previously offered by the NOAA AVHRR.

- High Resolution Imaging Spectrometer (HIRIS). HIRIS will provide 30 meter spectral resolution of reflected sunlight energy. The spectral resolution and range of HIRIS complements the historic capabilities of Landsat and SPOT systems. While SPOT and Landsat TM sensors offer 3 and 7 spectral bands respectively, the HIRIS sensor will offer 192 separate discrete spectral bands of data.

- Intermediate and Thermal Infrared Radiometer (ITIR). The multispectral thermal IR imaging capabilities of ITIR will complement HIRIS measurements and will offer an opportunity for global lithologic mapping using spectral bands that are currently unavailable. The sensor, developed by Japanese technicians, is an illustration of the international scope of scientific cooperation evolving through EOS.

- Multi-angle Spectro-Radiometer (MISR). Imaging at high off-nadir angles with sufficient sensitivity to separate surface and atmospheric effects related to measured radiances is a unique capability offered by the instrument.

- Synthetic Aperture Radar (SAR). Multispectral, multipolarization, multi-look-angle imaging radar will provide global surface coverage every 4 to 5 days of 200 meter resolution data, with special local resolution coverage of 20 meters. SAR will image the surface independent of cloud cover or environmental conditions, day and night.

- Multifrequency Imaging Microwave Radiometer (MIMR).25 km resolution, 6 channels, 1400 km swath imaging instrument for monitoring ice conditions and for measuring ocean-surface wind speed, soil moisture, precipitable water, and cloud and water content.

It is significant that the processing and distribution of the enormous data sets provided by the EOS instruments will continue the approaches and experiences of previous land data information systems. The historic collections of the past will be critical to the development of a record of global change. It is here that the EROS Data Center became an important factor in the EOS plans. Within EOS a system must be developed to provide hardware and software so researchers can access data and products derived from EOS instruments.

To that end, an EOS Data Systems Project Office has been formed. This team, headed by R. J. Thompson, will outline system requirements to assemble, process and distribute EOS and related data as the Center enters a new era in land related information research.

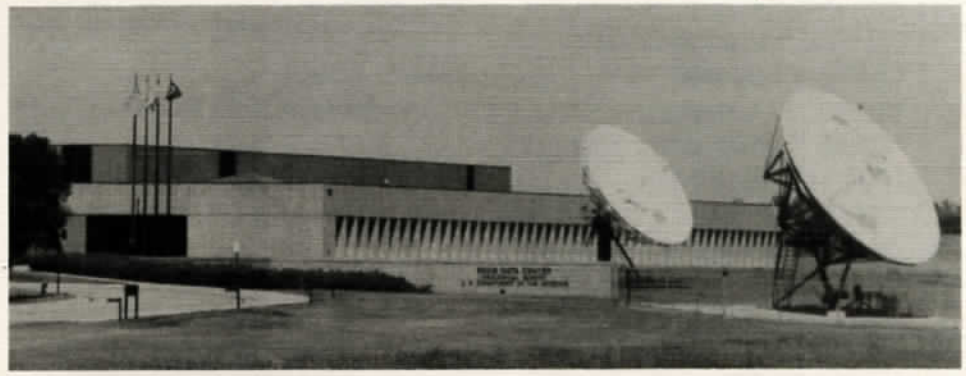
**In the next issue of *Center Scene*, plans for the distributed EOS Data and Information System (EOSDIS), and EDC's role in this complex assignment will be described.**

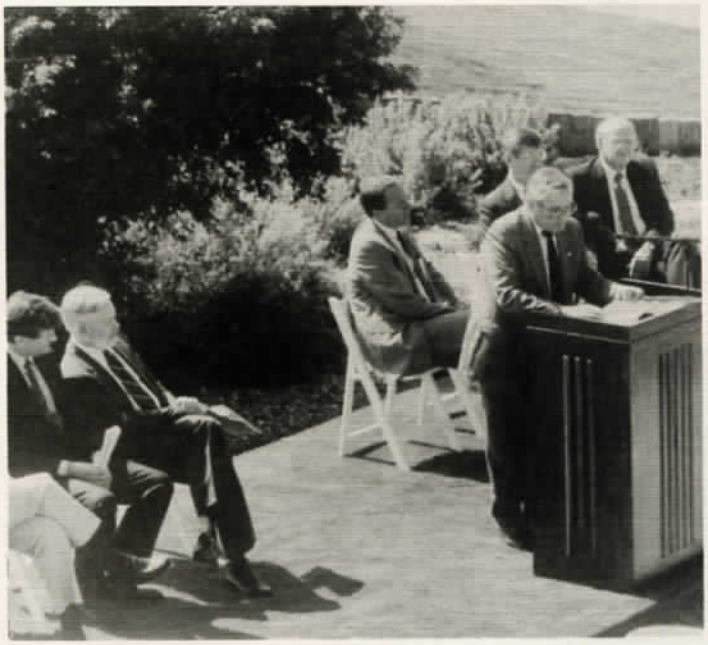
# Scenes from August 28th Dedication

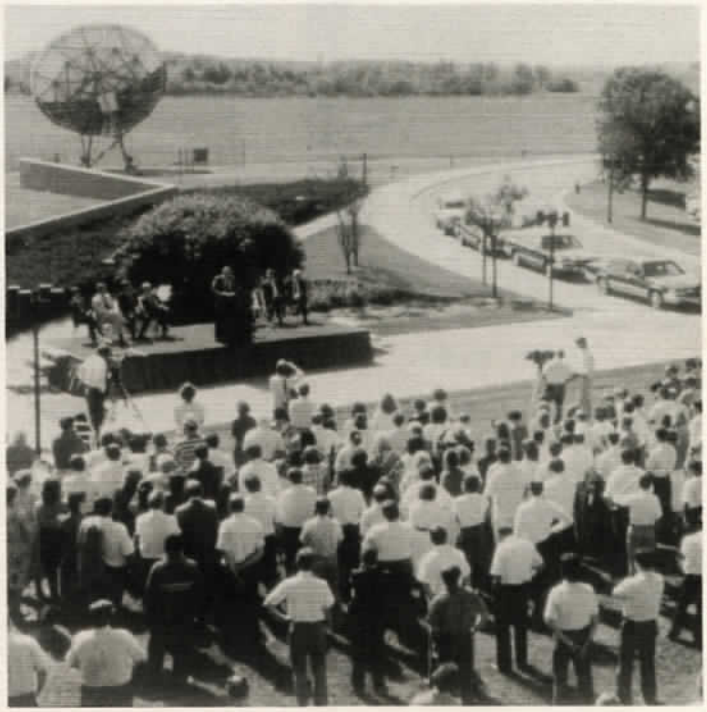
On August 28, 1990 NASA and the USGS dedicated flags at the EROS Data Center, in recognition of the Center's planned involvement in EOS. Attending were:

- Dr. Lennard Fisk, NASA Associate Administrator for Space Science
- Dr. Dallas L. Peck, Director, USGS
- Doyle G. Frederick, Associate Director, USGS
- Senator Larry Pressler
- Lowell E. Starr, Chief, National Mapping Division, USGS

and other federal and local dignitaries.





# Health Notes

## About Your Blood Pressure

| | |
|---|---|
| 120/80 | Normal |
| 140/90 | Borderline |
| 126/96 | Borderline High |
| 160/110 | Very High |

Hypertension, or high blood pressure (HBP) as it is more commonly known, is an elevation in diastolic or systolic blood pressure. Blood pressure (BP) is the force created as your heart pumps blood and moves it through your blood vessels.

Systolic blood pressure, the top number, measures the force while your heart pumps. A normal, healthy systolic BP is 140 or below.

Diastolic blood pressure, the bottom number, measures the force at rest—that is, between heart pumps. A normal, healthy diastolic BP is 90 or below. High diastolic BP is more of a concern because that means you have a high pressure exerted at all times on your vessels and they never really get a break.

A "text book" normal blood pressure reading has been designated as 120/80.

Hypertension is called the "silent killer" because you do not feel high blood pressure and only recognize the effects after the serious damage is done. Untreated hypertension can lead to several serious problems such as stroke, blindness, heart attack, heart failure, and even death.

Risk factors associated with hypertension include:

- Family history
- Race (most common in blacks)
- Stress*
- Obesity*
- High intake of fats and sodium*
- Use of tobacco or oral contraceptives*
- Sedentary lifestyle*
- Aging
- Excessive alcohol or caffeine consumption*

As you can see from this list of risk factors, many (*) can be controlled by the lifestyle we choose. Many of these changes are not easy, nor made over night, but luckily for us, they are goals that really can be attained. Changing some of our unhealthy habits not only helps to lower our blood pressure, but also with it comes increased motivation and a sense of pride that spills over into every aspect of our lives.

Checking your blood pressure is relatively easy and painless. You are most welcome to come to Health Service at any time and I will measure your blood pressure. Some EDC personnel, through regular monitoring at work, have reduced or eliminated their hypertension medication. There are several reasons why this regular monitoring can be helpful.

- For some individuals, it has been quite some time since they have monitored their blood pressure or medications with their physician.
- Many of us get nervous in the doctor's office and can get falsely high blood pressure readings (this is known as "white coat hypertension"). With regular blood pressure checks at work, some of the anxiety is reduced and thus, so is the blood pressure.
- Little experiments can be conducted whereby specific risk factors can be determined through a process of elimination and those that most significantly influence an individual's blood pressure can be spotted and eliminated (i.e., certain stressors, caffeine, weight loss, smoking, etc.).
- Many physicians feel more comfortable reducing or changing medications if the patient can be monitored regularly.

So here is an invitation to come to Health Service and have your blood pressure monitored. It is an exciting personal accomplishment for an individual to overcome the need for certain medications and decrease risk factors at the same time. Remember, you should never change or stop taking medication on your own. Controlling high blood pressure and monitoring borderline blood pressure (around 140/90) is very important and often slighted because it doesn't hurt. Hypertension affects 15-20% of U.S. adults and is a risk factor that should be taken very seriously

***Sue Rausch, Health Activities Specialist***

# HONORS AND AWARDS

***Allen H. Watkins***

Allen H. Watkins, Chief of the EROS Data Center, has been elected a member of the International Academy of Astronautics.

The International Academy of Astronautics was founded in 1960 in Stockholm, Sweden to foster the development of astronautics for peaceful purposes and to recognize individuals who have distinguished themselves in the science and technology of astronautics. Mr. Watkins was recognized for his contributions to the development of the technology of earth observations for space. The Academy has 1008 members from 57 countries.

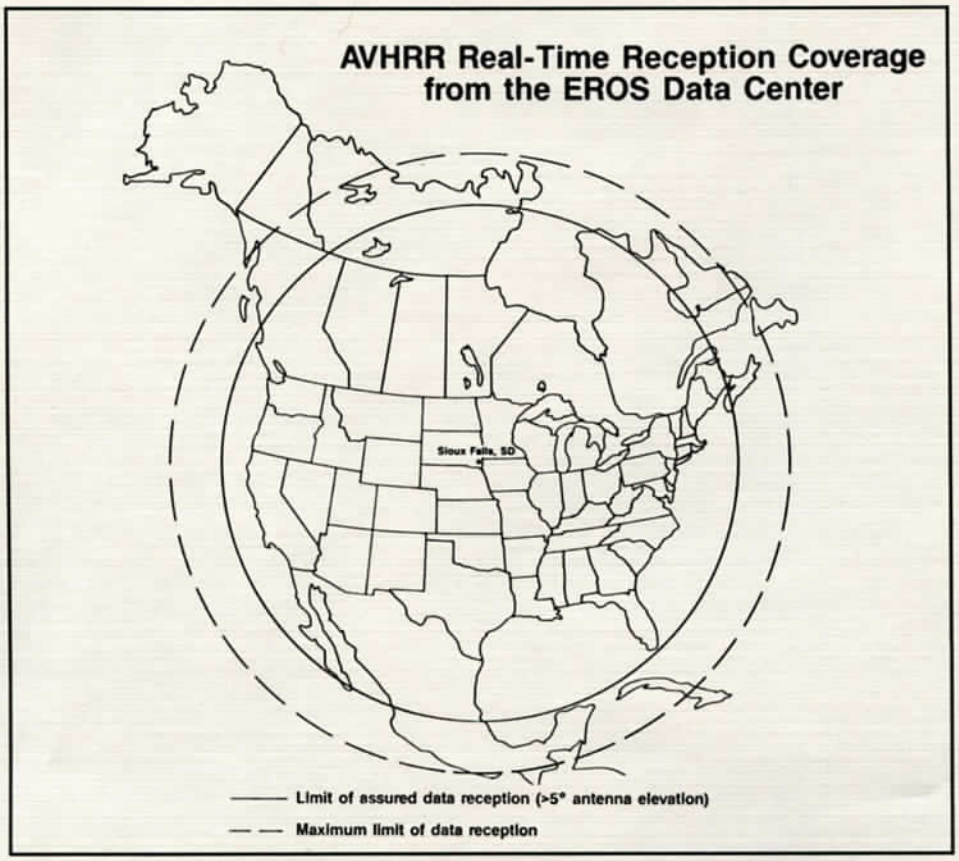
Watkins will be formally inducted into the Academy in October at the Joint Academy Meeting and 41st International Astronautical Congress in Dresden, GDR (East Germany) in October.

***June Thormodsgard***

A new publication planned by the Department of Interior will honor an EDC employee. To celebrate the importance of women to the accomplishments of the Department, a publication recognizing women who have made significant contributions to scientific programs is being prepared. June M. Thormodsgard, Manager of the Digital Image Sciences group will be recognized in the book.

Ms. Thormodsgard's scientific and managerial leadership roles are as unique as they are respected. An October 1, 1989 issue of the Sioux Falls Argus-Leader news story profiled her unique role. In the article, which identified Ms. Thormodsgard as the "...highest ranking woman administrator at the Survey's EROS Data Center," her scientific reputation and her managerial leadership were described as important to men and women in the community.

June Thormodsgard's excellent international reputation as an image processing scientist, and her leadership of a unique research team, qualify her for inclusion as among those recognized as important women within the Department of Interior.




## DOMSAT System Capability Expansion

The Advanced Very High Resolution Radiometer (AVHRR) Data Acquisition and Processing System (ADAPS) has, for three years, acquired all daytime and some nighttime passes of the active NOAA polar-orbiting satellites. A 3-meter-diameter tracking antenna on the building roof provides satellite reception within a 6200-kilometer-diameter circle centered on EDC. This coverage circle includes all of the conterminous U.S. and nearly all of Mexico and Canada. Currently, EDC acquires a total of 6 passes per day from NOAA-10 and NOAA-11. Daily acquisitions will grow to 9, with the launch of NOAA-12 in mid-1991.

The AVHRR instrument onboard the NOAA satellites scans the Earth 6 times per second in each of 5 spectral channels, using a large mirror that sweeps the Earth within an ultrawide 110° viewing angle. The two channels that sense reflected light in the green and red/infrared spectral bands are used most frequently for vegetation analysis — either as individual products or as time series image maps. The size of the ground element that is discretely, or individually, sampled is 1.1-kilometers square in the high-resolution mode, or 4.4-kilometers in the low-resolution mode. The wide field of view of the instrument and its coarse spatial resolution of the Earth, relative to Landsat or SPOT satellites, enables the instrument to electronically image the entire surface of the Earth every day. The instrument is valuable for continental and global land vegetation studies by Department of Interior agencies as well as for oceanographic research by universities and institutes, in addition to its primary role of providing atmospheric temperature and pressure profiles as well as cloud and snow mapping information to NOAA agencies.After being received at EDC, the data are processed to generate a photographic image, and the data are archived in raw form on computer-compatible magnetic tape (CCT). To date, approximately 8,000 satellite passes have been placed in our archive and indexed in an accession data base. That number will grow more quickly now than in the past, because a new policy stipulates that all acquired passes, rather than just the most-cloud-free passes, will be retained permanently.

EDC has acquired, via the 3-meter tracking antenna, more than 300 megabytes (MB) of AVHRR sensor data, daily, for the past three years. Currently, this data archive totals 325,000 MB. One way to visualize just how much data this amounts to is to compare it to an equivalent amount of full pages of typed alphabetic text: 163,000 8.5 x 11-inch typewritten pages, or a stack that rises five and one-half stories high. Another comparison can be made to a conversion of all the text and images in *Webster's New Collegiate Dictionary* to digital data bytes — that data set would equal 60 MB. EDC's AVHRR data holdings amount to 5,400 copies of this familiar 3-inch-thick desk reference. As large as this cumulative data set is, it represents only one of the two sources of satellite data utilized by NOAA. The other source is all of the data that are acquired worldwide and stored on the onboard satellite tape recorders, which are interrogated, or dumped, when the satellites pass over the two NOAA receiving stations, as many as 11 times every day. The satellites orbit the Earth a total of 14 times each day. Each recorder dump returns more than ten minutes of low- and high-resolution image data. That data, in turn, are relayed to NOAA's central processing facility in Suitland, MD via a domestic communications satellite called Domsat. Domsat's broadcast signal is non-directional, so the signal is received in Sioux Falls as easily and clearly as it is in Suitland.

Contained in the relayed AVHRR data stream are three types of data:

1) High-resolution picture transmission (HRPT) 1.1-km-ground-resolution multispectral image data acquired over all of Alaska and the eastern half of the U.S. These data are identical in format to the signals directly received by EDC's tracking antenna. Together with the EDC-acquired data, multispectral imagery of all of North America is received, processed, and archived daily.
2) Tape-recorded local area coverage (LAC) 1.1-km-ground-resolution data acquired over high interest areas around the world. These data are essentially the same as HRPT, but data generally are acquired as several short-duration passes for each orbit. This data allows research to be conducted over scientifically important regions of South America and Asia. Because the tape recorder is limited to approximately 11 minutes per orbit, and that recorder time must be shared with a body of research users, the Department of Defense, as well as NOAA, not all desired coverage can be obtained on a daily basis.
3) Tape-recorded global area coverage (GAC) 4.4-km-ground-resolution data acquired continuously worldwide. These data are an aggregation of the HRPT data, performed simply to reduce total data volume. The data are acquired in 14 continuous swaths that view the entire surface of the Earth each day. Because a 10-year archive of this data has been accumulated by NASA and other researchers, and because the data is acquired at a scale appropriate to global studies,

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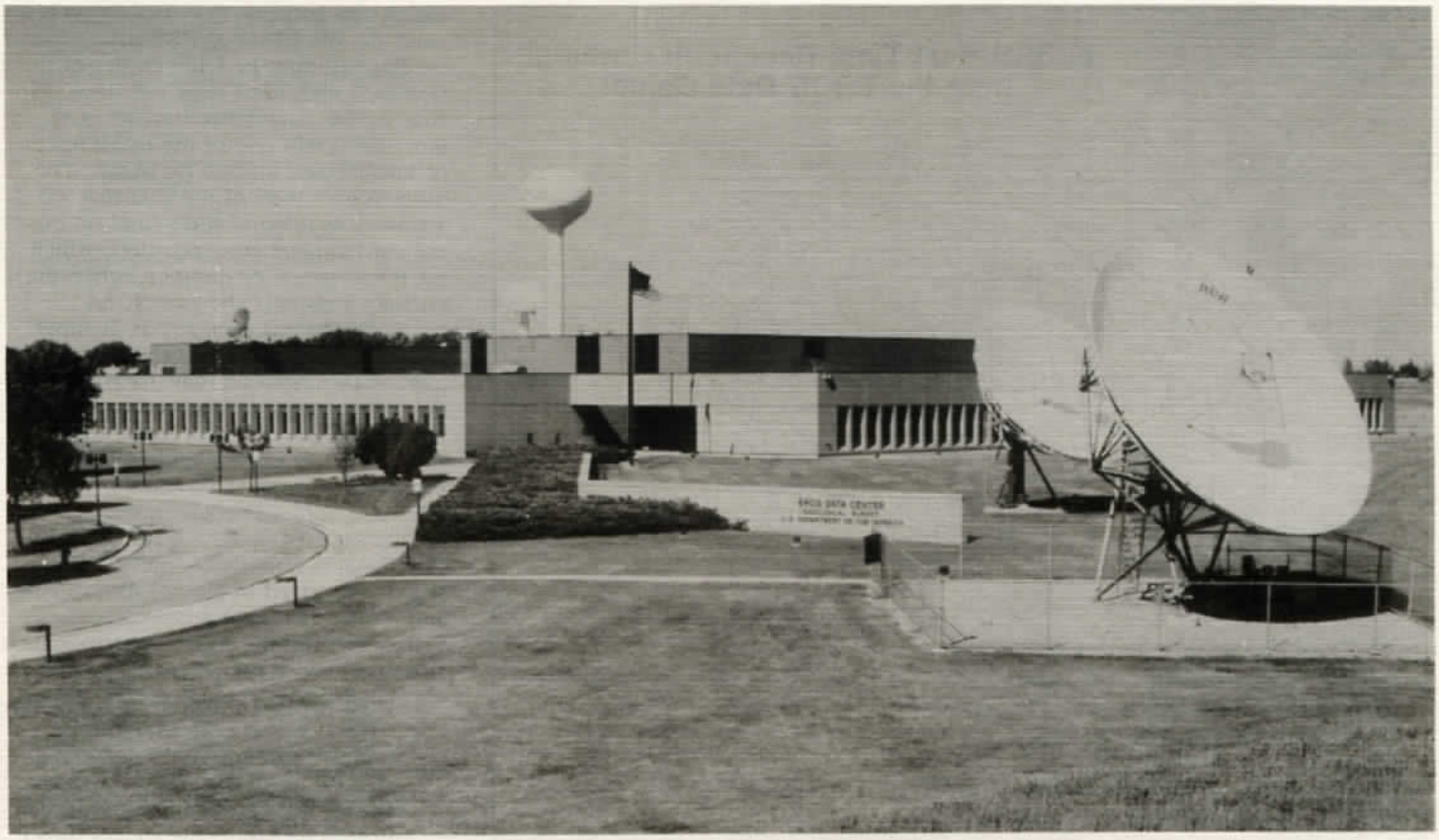

## DOMSAT

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the data may be especially useful for global vegetation change studies to be conducted over the next several years.

EDC will utilize the Domsat-relayed HRPT data to accomplish complete coverage of the North American continent, on a daily basis. LAC data will allow research to be conducted on Brazilian deforestation and other macro vegetation assessment studies, as well as to expand ongoing research on agriculture production enhancement and locust migration in Western Africa. Research programs incorporating the valuable ten-year GAC data archive are just beginning to be formulated, but these data may become very important in assessing the effects of climate change and land use on vegetation over the past decade. These studies are essential to enable predictions of future climatic and environmental conditions, as they apply to land biomass, to be made more accurately. Because the Domsat antenna extends the AVHRR reception range to encircle not only all of North America but the entire world, data archival requirements to support current as well as future data needs for global vegetation monitoring will expand enormously. Daily acquisitions will quadruple, to 25 pass segments. A moderately powerful VAX-based minicomputer is being added to the system, simultaneously with the installation of the antenna, in order to process the additional volume of passes to the AVHRR tape archive. Daily data archival volume will equal approximately one gigabyte (1000 MB.)

The antenna itself is an 8.1-meter-diameter fixed-pointed parabolic reflector on an azimuth/elevation mount. This means that the antenna can be repositioned easily if the data stream were to be rerouted through a different satellite. A more complex tracking antenna is not required, because the Domsat satellite is geosynchronous; that is, it is stationary relative to a point on the Earth. The 8.1-meter reflector collects sufficient radio signal and concentrates it to provide 50 decibels of gain, which means that the Domsat signal becomes 100,000 times stronger than it would be if it were received via a simple wire (dipole) antenna. (The five-foot-long T-shaped antenna supplied with many TV's and VCR's is a dipole antenna.)

In addition to the reflector and a small subreflector, the antenna also includes two receive elements, called feeds, and one transmit element. Currently, only one receive feed is being used. In the future, both receive feeds and the transmit feed could operate simultaneously. Also, the AVHRR Domsat antenna is pointed at the same GE/RCA F2 satellite as the existing Landsat reception antenna, differing only in the actual transponder (or relay transmitter) through which the signal is routed. Transponders differ in signal frequency, antenna polarization, data rate, and broadcast time-slot assignments. Although it is unlikely to be necessary, in the future the AVHRR Domsat antenna could provide reception of the Landsat MSS data stream as well.

Once inside the building, the AVHRR signal is split into two data channels, each operating at 1.3 megabits per second. (The AVHRR data rate is significantly slower than the Landsat MSS rate of 15 megabits per second.) Data may be uplinked from Fairbanks and Wallops Island simultaneously, each station transmitting on its own channel. Both data channels are decoded into digital signals and fed simultaneously into the processing computer. The aggregate data rate of both AVHRR data channels on Domsat is four times greater than the standard direct-receive data rate of 0.65 megabits per second.

Software has been enhanced to accommodate the multiple data types, data sources, and 24-hour data availablilty introduced by the Domsat-received data. Scheduling software must now incorporate the temporal and geographic coordinates of the spacecraft at the moment of image acquisition. It must also incorporate the tape-recorder playback and Domsat uplink schedules that are prepared daily. Fortunately, both schedules are available on a NOAA electronic bulletin board.

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